



# Mammograms and Other Breast Imaging Procedures

## What is a mammogram?

A mammogram is an x-ray exam of the breast. It is used to detect and evaluate breast changes. Mammograms are most often used to look for breast cancer that is too small to be felt in women who have no breast complaints or symptoms. These are called *screening mammograms*.

Mammograms are also used in women who have breast symptoms, such as a lump, pain, nipple discharge, or who have a suspicious change seen on a screening mammogram. These are called *diagnostic mammograms*.

X-rays were first used to examine the breasts more than 90 years ago. But modern mammography has only existed since the late 1960s, when the first x-ray machines used just for breast imaging became available. Since then, the technology has advanced a lot, and today's mammogram is very different even from those of the mid-1980s.

The special type of x-ray machine used for the breasts produces lower energy x-rays. These x-rays do not go through tissue as easily as those used for routine chest x-rays or x-rays of the arms or legs, but this improves the contrast of the image. Mammograms today expose the breast to much lower doses of radiation compared with devices used in the past.

## Screening mammograms

A screening mammogram is an x-ray exam of the breast on a woman who has no symptoms. The goal of a screening mammogram is to find cancer when it is still too small to be felt by a woman or her doctor. Finding small breast cancers early with a screening mammogram greatly improves a woman's chance for successful treatment.

A screening mammogram usually takes 2 x-ray pictures (views) of each breast. Some patients, such as those with large breasts, may need to have more pictures to see as much breast tissue as possible.

### **How is a mammogram done?**

When you have a mammogram, your breast is compressed or squeezed between 2 plates attached to the mammogram machine -- a plastic plate (on top) and an x-ray plate (on the bottom). The technologist compresses your breast to keep it from moving, and to make the layer of breast tissue thinner. These measures reduce the x-ray exposure, reduce blurring, and make the picture sharper. Although the compression can feel uncomfortable and even painful for some women, it only lasts for a few seconds and is needed to get a good picture. The entire procedure for a mammogram takes about 20 minutes.



### **The x-ray device and compression plates used for mammograms**

Mammograms produce a black and white x-ray picture of the breast tissue. Depending on the type of machine, the picture is either on a large sheet of x-ray film or is an electronic image that can be seen on a computer screen. Today, more than half of the mammography units used are *screen-film units*, which means they produce the mammogram picture on x-ray film. The other half are newer *full-field digital mammography units*, which capture the picture in digital format that can be looked at on a computer screen.

No matter what kind of x-ray image is taken -- film or electronic -- it is interpreted (or "read") by a doctor, most often a radiologist. Radiologists are doctors who have special training in diagnosing diseases by looking at pictures of the inside of the body produced by x-rays, sound waves, magnetic fields, or other methods. Other doctors who treat breast diseases may look at the mammogram, too.

Reading mammograms is challenging. The way the breast looks on a mammogram varies a great deal from woman to woman. And some breast cancers may cause changes in the mammogram that are hard to notice. If you have had mammograms in the past, it is very important that the radiologist has the x-ray films or digital pictures so they can be compared with the new ones (not just the report). Comparing the pictures helps the doctor find small changes and detect a cancer as early as possible. Because it can be hard to get

your older pictures, it is best to find a facility that you are comfortable with and plan to get your regular mammograms there each year. That way, your other pictures will be there and easy to find.

## **American Cancer Society recommendations for early breast cancer detection**

**Women age 40 and older should have a screening mammogram every year, and should continue to do so for as long as they are in good health.**

Current evidence supporting mammograms is even stronger than in the past. Recent evidence has confirmed that mammograms offer substantial benefit for women starting in their 40s. Women can feel confident about the benefits associated with regular mammograms for finding cancer early.

But mammograms do have some limitations. Although mammograms will detect most breast cancers, some will be missed. Also, sometimes signs on a mammogram that look abnormal may require a biopsy (the removal of a sample of tissue to see whether cancer cells are present) that will turn out *not* to be breast cancer. In this instance, a woman has undergone a procedure for an abnormality that wasn't cancer, and she has been through a period of feeling anxious about the possibility of having breast cancer. New research suggests a small percentage of breast cancers, especially a pre-cancerous condition called ductal carcinoma in situ, may not ever become life threatening, so treatment of these cancers is not necessary. (This is referred to as "overdiagnosis.") But mammograms, despite their limitations, are the most effective and valuable tool for decreasing suffering and death from breast cancer. Women should be told about the benefits, limitations, and potential harms linked with regular screening.

There is no fixed age at which women should stop getting mammograms. Mammograms for older women should be based on the woman's health and whether or not she has other serious illnesses. Age alone should not be the reason to stop having regular mammograms. As long as a woman is in good health and would be a candidate for treatment if she developed breast cancer, she should continue to have screening mammograms.

**Women in their 20s and 30s should have a clinical breast exam (CBE) as part of a periodic (regular) health exam by a health professional, preferably every 3 years. After age 40, women should have a breast exam by a health professional every year.**

CBE gives a better picture of breast problems than that offered by mammograms alone. It offers a chance for women to discuss breast changes with their doctors, physician assistants, or nurses. They can also talk about the importance of early detection and factors in the woman's history that might make her more likely to have breast cancer.

There may be some benefit in having the CBE shortly before the mammogram, because if the examiner detects an abnormality the mammogram can be done in such a way to pay closer attention to that area of the breast. The exam should include teaching and feedback

so you will get more familiar with your own breasts. Women should also be given information about the benefits and limitations of CBE and breast self-exam (BSE). Breast cancer risk is very low for women in their 20s and slowly increases with age. Women should be told to report any new breast symptoms to a health professional right away.

Like mammography, the person doing a CBE will not find all breast cancers, and some masses that are felt will lead to a referral for biopsy and will be found not to be breast cancer.

**Breast self-exam (BSE) is an option for women starting in their 20s. Women should be told about the benefits and limitations of BSE. Women should report any breast changes to a health professional right away.**

Research has shown that BSE plays a small role in finding breast cancer compared with finding a breast lump by chance by a woman who knows what is normal for her. Some women feel very comfortable doing BSE (which is a systematic, step-by-step approach to looking at and feeling one's breasts) regularly, usually monthly. Other women are more comfortable simply looking and feeling their breasts in a less systematic approach, such as while showering or getting dressed, or doing an occasional thorough exam.

Sometimes, women are so concerned about "doing it right" that they become stressed over the technique. Doing BSE regularly is one way for women to know how their breasts normally look and feel and to notice any changes. The goal, with or without BSE, is to find and report any breast changes to a doctor or nurse right away.

Women who choose to do BSE should have their BSE technique reviewed during their physical exam by a health professional. It is OK for women to choose not to do BSE or not to do it on a regular schedule. But by doing the exam regularly, you get to know how your breasts normally look and feel and you can more readily detect a change that occurs, such as development of a lump or swelling, skin irritation or dimpling, nipple pain or retraction (turning inward), redness or scaliness of the nipple or breast skin, or a discharge other than breast milk. Should you notice any changes you should see a health professional as soon as you can. But remember that most of the time these breast changes are not cancer.

As with mammography and CBE, women with BSE will not always find a breast cancer during self-exam. They also may feel a lump which could lead to a biopsy that is found to not be cancer.

**Women at high risk of breast cancer (about 20% or greater lifetime risk based on a detailed family history or a history of radiation treatments at a young age), should get an MRI (magnetic resonance imaging) and a mammogram every year beginning at age 30 (see below). Women at moderately increased risk (15% to 20% lifetime risk) should talk with their doctors about the benefits and limitations of adding MRI screening to their yearly mammogram. Yearly MRI screening is not recommended for women whose lifetime risk of breast cancer is less than 15%.**

**Women at high risk include those who:**

- Have a known BRCA1 or BRCA2 gene mutation

- Have a first-degree relative (mother, father, brother, sister, or child) with a BRCA1 or BRCA2 gene mutation, and have not had genetic testing themselves
- Have a lifetime risk of breast cancer of about 20% to 25% or greater, according to risk assessment tools that are based mainly on a family history that includes both her mother's and father's side
- Had radiation therapy to the chest when they were between the ages of 10 and 30 years
- Have a genetic disease such as Li-Fraumeni syndrome, Cowden syndrome, or hereditary diffuse gastric cancer, or have a first-degree relative with one of these syndromes

**Women at moderately increased risk include those who:**

- Have a lifetime risk of breast cancer of 15% to 20%, according to risk assessment tools that are based mainly on family history (see below)
- Have had breast cancer, ductal carcinoma in situ (DCIS), lobular carcinoma in situ (LCIS), atypical ductal hyperplasia (ADH), or atypical lobular hyperplasia (ALH)
- Have extremely dense breasts or unevenly dense breasts when viewed by mammograms

If MRI is used, it should be in addition to, not instead of, a screening mammogram. This is because while an MRI is more likely to detect cancer than a mammogram, it may still miss some cancers that a mammogram would detect.

For most women at high risk, screening with MRI and mammograms should begin at age 30 years and continue for as long as a woman is in good health. But because the evidence is limited regarding the best age at which to start screening, some organizations recommend an earlier age. The decision about when to begin screening should be based on shared decision making between patients and their health care providers, taking into account personal circumstances and preferences.

Several risk assessment tools, with names such as the Gail model, the Claus model, BRACAPRO, BOADICEA, and the Tyrer-Cuzick model, are available to help health professionals estimate a woman's breast cancer risk. These tools give approximate, rather than precise, estimates of breast cancer risk based on different combinations of risk factors and different data sets. As a result, the different tools may give different risk estimates for the same woman. For example, the Gail model bases its risk estimates on certain personal risk factors, such as age at menarche and history of prior breast biopsies, along with any history of breast cancer in a woman's first-degree relatives on her mother's side. (So, the Gail model is not useful for determining if a woman may have inherited a mutation on a breast cancer susceptibility gene.) The Claus model estimates risk based on family history of breast cancer in both first and second-degree relatives. These 2 models could easily give different estimates for the same person. Results obtained from any of the risk assessment tools should be discussed by a woman and her doctor when being used to decide whether to start MRI screening.

Women who get screening MRI should do so only at a facility that can do an MRI-guided breast biopsy at the same time if needed. Otherwise, the woman with positive findings will have to have a second MRI exam at another facility where a biopsy can be done.

There is no evidence at this time that MRI will be an effective screening tool for women at average risk. While MRI is more sensitive than mammograms in very high-risk women, it also has a higher false positive rate (where the test finds things that turn out to not be cancer). This would lead to unneeded biopsies and other tests in many of these women.

The American Cancer Society believes the use of regular mammograms, MRI (in women at high risk), clinical breast exams, and finding and reporting breast changes early, according to the recommendations outlined above, offers women the best chance for detecting breast cancer at an early, more favorable stage. This combined approach is clearly better than any one test. Without question, breast physical exam without mammograms would miss many breast cancers that are too small for a woman or her doctor to feel but can be seen on mammograms. Although a mammogram is a sensitive screening method, a small percentage of breast cancers do not show up on mammograms but can still be felt by a woman or her doctor. For women at high risk of breast cancer, such as those with BRCA gene mutations or a strong family history, both MRI and mammogram exams of the breast are recommended.

## Diagnostic mammograms

A diagnostic mammogram is an x-ray exam of the breast in a woman who either has a breast problem (for example, a breast lump, nipple discharge, etc.) or has had a change show up on a screening mammogram. During a diagnostic mammogram, more pictures are taken to carefully study the area of concern. In most cases, special pictures are enlarged to make a small area of suspicious breast tissue bigger and easier to evaluate. Many other types of x-ray pictures can be done, depending on the type of problem and where it is in the breast. For example, a diagnostic mammogram may offer a closer look and show that an area that looked abnormal is actually normal. When this happens, the woman goes back to routine yearly screening.

It also could show that an area of abnormal tissue is *probably not* cancer. When this happens it is common to ask the woman to return to be re-checked, usually in 4 to 6 months.

Finally, the diagnostic work-up may suggest that a biopsy is needed to tell whether or not the abnormal area is cancer. If your doctor recommends that you have a biopsy done, it does not mean that you have cancer. About 80% of all breast changes that are biopsied are found to be benign (not cancer) when looked at under the microscope. If a biopsy is needed, you should discuss the different types of biopsy (see "Imaging-guided breast biopsy" section) with your doctor to decide which type is best for you.

# Tips for having a mammogram

These tips help you have a good quality mammogram:

- If it is not posted in a place you can see it (often near the receptionist's desk), ask to see the FDA certificate that is issued to all facilities that offer mammograms. The FDA requires all facilities to meet high professional standards of safety and quality in order to provide mammogram services. Facilities that are not certified may not provide mammogram services.
- Use a facility that specializes in mammograms and does many mammograms a day.
- If you are satisfied that the facility is of high quality, continue to go there on a regular basis so that your mammograms can be compared from year to year.
- If you are going to a facility for the first time, bring a list of the places, dates of mammograms, biopsies, or other breast treatments you have had before. If you have had mammograms at another facility, you should try to get those mammograms to bring with you to the new facility (or have them sent there) so that they can be compared to the new ones.
- On the day of the exam, don't wear deodorant or antiperspirant. Some of these have substances that can show up on the x-ray as white spots. If you're not returning home, you may want to take some with you apply it after your exam.
- You may find it easier to wear a skirt or pants, so that you'll only need to remove your top and bra for the mammogram.
- If you are still having periods, try to not schedule your mammogram for the week just before your period. Schedule it when your breasts are not tender or swollen to help reduce discomfort and get a good picture.
- Always describe any breast symptoms or problems you are having to the technologist who is doing the mammogram. Be prepared to describe any related medical history such as surgeries, hormone use, and any breast cancer that you or a family member has had. Also talk to your doctor or nurse about any new findings or problems in your breasts before having the mammogram.
- Before having any type of imaging test, tell your radiology technologist if you are breast-feeding or if you think you might be pregnant.
- If you do not hear from your doctor within 10 days, do not assume that your mammogram was normal; call your doctor or the facility.

# What to expect when you have a mammogram

- You will have to undress above the waist to have a mammogram. The facility will provide a wrap for you to wear.
- A technologist will position your breasts for the mammogram and will take at least 2 x-rays of each breast. Most technologists are women. You and the technologist are the only ones in the room during the mammogram.
- The whole procedure takes about 20 minutes. The actual breast compression only lasts a few seconds.
- You may feel some discomfort or even pain when your breasts are compressed. If you are in pain, tell the technologist so she can try to make the compression more comfortable for you.
- All mammogram facilities are now required to send your results to you within 30 days. In most cases, you will be contacted within 5 working days if there is a problem with the mammogram.
- On average, only 2 to 4 screening mammograms of every 1,000 lead to a diagnosis of breast cancer. About 10% of women who have a mammogram will need more tests, but most will only need another mammogram. Don't panic if this happens to you. Only 8% to 10% of those women will need a biopsy, and most (80%) of those biopsies will not be cancer.

If you are a woman age 40 or over, you should get a mammogram every year. You can schedule the next one while you're there at the facility. Or you can ask for a reminder to schedule it as the date gets closer. Some women schedule the next year's mammogram and ask to be reminded of the appointment a few weeks ahead of time.

## Help with mammogram costs

Medicare, Medicaid, and most private health insurance plans cover mammogram costs, or at least part of them. Low-cost mammograms are available in most areas. Call the American Cancer Society at 1-800-227-2345 for information about facilities in your area. The National Breast and Cervical Cancer Early Detection Program (NBCCEDP) also provides breast and cervical cancer early detection testing to women without health insurance for free or at very little cost. To learn more about this program, please contact the Centers for Disease Control and Prevention (CDC) at 1-800-CDC INFO (1-800-232-4636) or visit their Web site at [www.cdc.gov/cancer](http://www.cdc.gov/cancer).

# Regulation of mammography

In the United States, mammography is highly regulated. Although the quality of mammography has improved since its introduction in the late 1960s, studies in the mid-1980s showed that quality varied greatly from place to place. In an attempt to educate those working with mammograms, improve quality, and lower the dose of radiation, the American Cancer Society approached the American College of Radiology (ACR) and requested that it establish standards and criteria that would help women and doctors find those facilities that provided high-quality screening services. In 1986, the ACR started the first national Mammography Accreditation Program (MAP). This voluntary program raised standards nationwide and led to better mammogram services at those sites that took part in the program.

In 1992, Congress passed a law to apply standards like these to all mammogram facilities. The standards are now required, and today the US Food and Drug Administration (FDA) must certify each mammogram facility (except those of the Department of Veterans Affairs). In order to be certified, the equipment, personnel, and practice of the facility must be reviewed by an FDA-approved accreditation body and meet the following criteria:

- Each mammography unit has to be accredited.
- Certain staff members must meet strict standards including:
  - Radiologists (the doctors who interpret the mammograms)
  - Radiology technologists (those who actually position women for the mammogram and take the pictures)
  - Medical physicists (professionals who specialize in medical equipment and image production)
- Typical x-rays are reviewed for quality and information on radiation dose, which is required to be very low.

If the facility meets all of the required standards, the FDA gives its certification. These standards are outlined in the Mammography Quality Standards Act (MQSA), which has been in effect since 1994. It is unlawful to do mammograms in the United States without an FDA certificate.

The FDA has a list of all of its certified mammography facilities by state and zip code. This list is available at the FDA's Web site:  
[www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm](http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm).

## Reporting results

Mammogram clinics are now required to notify women in writing about the results of their mammograms. The Mammography Quality Standards Act was put in place in response to reports that some women may not have learned soon enough that they had suspicious mammogram results. Mammogram clinics still report mammogram results to the woman's doctor, too, who is responsible for ordering more tests or treatments, if

needed. A newer part of the regulation requires clinics to mail women a separate, easy-to-understand report of their mammogram results within 30 days -- sooner if the results suggest cancer is present -- so that the woman may know the results even if her doctor has not yet called to tell her.

## **Radiation exposure from mammography**

The modern mammography machine uses low radiation doses to produce breast x-rays that are high in image quality (usually about 0.1 to 0.2 rads per picture). Older mammography units delivered higher doses, and led to concerns about radiation risks. These older machines are no longer used.

Strict guidelines ensure that mammography equipment is safe and uses the lowest dose of radiation possible. Many people are concerned about the exposure to x-rays, but the level of radiation from a mammogram today does not significantly increase the breast cancer risk for a woman who gets regular mammograms.

To put dose into perspective, if a woman with breast cancer is treated with radiation, she will likely get a total of around 5,000 rads (a *rad* is a measure of radiation dose). If she has yearly mammograms starting at age 40 and continues until she is 90, she will get a total of 20 to 40 rads. To put it another way, the dose of radiation that she gets during a screening mammogram is about the same amount of radiation from her natural surroundings (background radiation) she would average over about 3 months.

## **What does the doctor look for on a mammogram?**

The doctor reading your films will look for different types of changes:

### **Calcifications**

Calcifications are tiny mineral deposits within the breast tissue. They look like small white spots on a mammogram. Calcifications are usually not associated with breast cancer. Calcifications are described in many ways, but there mainly are 2 types of calcifications.

### **Macrocalcifications**

Macrocalcifications are coarse (larger) calcium deposits that are most likely associated with changes in the breasts caused by aging of the breast arteries, old injuries, or inflammation. These deposits are related to non-cancerous conditions and usually do not require a biopsy. Macrocalcifications are found in about half the women over 50, and in 1 of 10 women under 50.

## Microcalcifications

Microcalcifications are tiny specks of calcium in the breast. They may show up alone or in clusters. Microcalcifications seen on a mammogram are more of a cause for concern, but still usually do not mean that cancer is present. The shape and layout of microcalcifications help the radiologist judge how likely it is that cancer is present. In most cases, the presence of microcalcifications does not mean a biopsy is needed. But if the microcalcifications have a suspicious look and pattern, the radiologist may recommend a biopsy.

## A mass or cyst

A mass, with or without calcifications, is another important change seen on mammograms. Masses can be many things, including cysts (non-cancerous, fluid-filled sacs) and non-cancerous solid tumors (such as fibroadenomas). But they also could be cancer. If they are not cysts, they usually should be biopsied.

Cysts cannot be diagnosed by just a physical exam, nor can they be diagnosed by just a mammogram. To be sure that a mass is really a cyst, either breast ultrasound is needed or the fluid must be removed with a thin, hollow needle (this is called *aspiration*).

If a mass is not a simple cyst (that is, if it is at least partly solid), then more imaging tests may be needed. Some masses can be watched with regular mammograms, while others may need a biopsy. The size, shape, and margins (edges) of the mass may help the radiologist determine if cancer is present.

Your prior mammograms may help show that a mass has not changed for many years. This would mean that the mass is likely benign (not cancer) and a biopsy is not needed. Having your prior mammograms available for the radiologist, as discussed above, is very important.

A mammogram may show something suspicious, but by itself it cannot prove that an abnormal area is cancer. If a mammogram raises a suspicion of cancer, tissue must be taken out and looked at under the microscope to tell if it is cancer. This can be done with a needle biopsy or an open surgical biopsy (described in the "Imaging-guided breast biopsy" section).

## Mammogram reports

The American College of Radiology (ACR) has developed a standard way of describing mammogram findings. In this system, the results are given a code (numbered 0 through 6). This system is called the Breast Imaging Reporting and Data System (BI-RADS). Having a standard way of reporting mammogram results lets doctors use the same words and terms and ensures better follow up of suspicious findings.

# Breast Imaging Reporting and Data System

## **Assessment is incomplete**

### **Category 0: Additional imaging evaluation and/or comparison to prior mammograms is needed.**

- This means a possible abnormality may not be clearly seen or defined and more tests are needed, such as the use of spot compression (applying compression to a smaller area), magnified views, special mammogram views, or ultrasound. This also suggests that the mammogram should be compared with older ones to see if there have been changes in the area over time.

## **Assessment is complete**

### **Category 1: Negative**

- In this case, there is no significant abnormality to report. The breasts look the same (they are symmetrical) with no masses, distorted structures, or suspicious calcifications. In this case, negative means nothing bad was found.

### **Category 2: Benign (non-cancerous) finding**

- This is also a negative mammogram result, but the reporting doctor chooses to describe a finding known to be benign, such as benign calcifications, intra-mammary lymph nodes, or calcified fibroadenomas. This ensures that others who look at the mammogram will not misinterpret this benign finding as suspicious. This finding is recorded in the mammogram report to help compare with future mammograms.

### **Category 3: Probably benign finding -- Follow-up in a short time frame is suggested**

- The findings in this category have a very good chance (greater than 98%) of being benign (not cancer). The findings are not expected to change over time. But since it is not proven benign, it is helpful to see if an area of concern does change over time. Follow-up with repeat imaging is usually done in 6 months and regularly thereafter until the finding is known to be stable (usually at least 2 years). This approach helps avoid unnecessary biopsies but allows for early diagnosis of a cancer should the suspicious area change over time.

### **Category 4: Suspicious abnormality -- Biopsy should be considered**

- Findings do not definitely look like cancer but could be cancer. The radiologist is concerned enough to recommend a biopsy. The findings in this category can have a wide range of suspicion levels. For this reason, some doctors may divide this category further:
  - 4A: finding with a low suspicion of being cancer
  - 4B: finding with an intermediate suspicion of being cancer
  - 4C: finding of moderate concern of being cancer, but not as high as Category 5

But not all doctors use these subcategories.

**Category 5: Highly suggestive of malignancy -- Appropriate action should be taken**

- The findings look like cancer and have a high chance (at least 95%) of being cancer. Biopsy is very strongly recommended.

**Category 6: Known biopsy-proven malignancy -- Appropriate action should be taken**

- This category is only used for findings on a mammogram that have already been shown to be cancer by a previous biopsy.

## Imaging-guided breast biopsy

A suspicious area in the breast may be found by physical exam, mammogram or another imaging method, or by some combination of these. But no matter of how it was found, the only way to know for sure if it is cancer is by doing a *biopsy*. This means a sample of cells or tissue is taken from the area and looked at under the microscope. For suspicious areas that cannot be felt (and even for some that can), imaging tests may be done to be sure the right area is biopsied. There are several types of biopsies.

### Surgical biopsy

For years, *open* or *surgical* biopsy was a woman's only biopsy option. Usually this is an *excisional* biopsy, where the surgeon makes a cut in the skin of the breast and takes out all of the abnormal area (lesion). At the same time, the surgeon takes a narrow zone of the surrounding normal tissue (called the *margin*). If the mass is too large to be removed easily, an *incisional* biopsy may be done instead. In this type, only part of the mass is removed. Either type of surgical biopsy often will mean you need stitches and it might leave a scar at the incision site.

**Wire localization** is a procedure used to guide a surgical breast biopsy of a small mass that may be hard for the surgeon to find. It can also be useful for areas that look suspicious on the x-ray (due to calcifications, for example) but do not have a lump that can be felt. After numbing the area with local anesthetic (a drug to numb the skin), a very thin hollow needle is put in the breast. X-rays are used to guide the needle to the suspicious area. A thin wire is then slid through the needle. A small hook at the end of the wire keeps it in place. The hollow needle is then removed. The surgeon uses the wire as a guide to find the abnormal area that needs to be removed.

### Needle biopsy

Many suspicious breast changes can be diagnosed without surgery by using a *needle* biopsy. There are 2 types of needle biopsies:

- **Fine needle aspiration (FNA) biopsy** uses a very thin, hollow needle to remove fluid and tiny bits of tissue.

- **Core needle biopsy (CNB)** uses a slightly larger needle to remove a piece of tissue about 1/16-inch in diameter and ½ inch long.

Usually 2 or more samples are taken with either of these techniques.

If the breast mass is large enough to be felt, the doctor can do a needle biopsy by guiding the needle right into the lump.

If the mass is too small or too deep within the breast to be felt, biopsies are done using breast imaging methods to guide the needle into the area. For example, *ultrasound* can be used so that the doctor can see the needle on a screen as it moves toward and into the mass.

**Stereotactic needle biopsy** is useful in cases in which calcifications or a mass can be seen on mammogram but cannot be felt. Based on mammograms taken from 2 angles, computers help map the exact location of the mass or calcifications and guide the placement of the needle for CNB or, less often, FNA biopsy.

**Stereotactic core needle biopsy** can sample breast changes felt by the doctor, as well as smaller ones pinpointed by ultrasound or mammogram. Depending on whether the abnormal area can be felt, about 3 to 5 cores are usually removed.

The needle used in core biopsies is larger than that used in FNA. It removes a small cylinder of tissue (about 1/16- to 1/8-inch in diameter and ½-inch long) from a breast abnormality. The biopsy is done with local anesthesia (drugs are used to make the area numb) in an outpatient setting.

Two stereotactic biopsy methods can remove more tissue than a core biopsy.

- The Mammotome® and the ATEC® (Automated Tissue Excision and Collection) are types of *vacuum-assisted biopsy*. In this procedure the skin is numbed and a small cut (about ¼-inch) is made. A hollow probe is put through the cut into the abnormal area of breast tissue. The probe can be guided into place using x-rays or ultrasound (or MRI in the case of the ATEC system). A cylinder of tissue is then suctioned through a hole in the side of the probe, and a rotating knife within the probe cuts the tissue sample from the rest of the breast. Several samples can be taken from the same incision. Vacuum-assisted biopsies are done as an outpatient procedure. No stitches are needed and there is little scarring.
- The *ABBI method* (Advanced Breast Biopsy Instrument) uses a probe with a rotating circular knife and thin heated electrical wire to remove a large cylinder of abnormal tissue. While in some cases it may be able to remove an entire mass, it also removes more normal breast tissue than other core biopsy techniques. A few stitches are usually needed afterward. ABBI is more likely to leave a small scar.

## How does the doctor know which type of biopsy I need?

The accuracy rates for the different types of biopsy techniques seem to be much the same, but the accuracy of each method depends largely on the doctor's experience with that method. This is especially true with methods that remove smaller amounts of tissue (like

FNA and core needle biopsy) because these require more accurate placement of the needle.

Each type of biopsy has pros and cons. The choice of which to use depends on each patient's situation and needs. Some of the factors to think about include:

- How suspicious the lesion looks
- How large it is
- Where it is in the breast
- How many lesions are present
- Other medical problems the patient may have
- The patient's personal preferences

Women are encouraged to discuss the pros and cons of different biopsy types with their doctors, and to have the procedure done by a doctor with experience in the chosen technique.

## **Mammograms in special circumstances**

### **Mammograms in younger women**

Mammograms are harder to read in younger women, usually because their breasts are dense and this can hide a tumor. Since most breast cancers occur in older women, this is usually not a problem. Screening mammograms are not recommended for average-risk women under age 40.

In younger women who are at high risk for developing breast cancer (due to a BRCA1 or BRCA2 gene mutation, a strong family history, or other factors), yearly breast MRIs and mammograms are recommended. For most of these women, screening should begin at age 30 years and continue for as long as the woman is in good health. But because the evidence about the best age at which to start screening is limited, this decision should be based on discussions between patients and their health care providers, taking into account personal circumstances and preferences.

### **Mammograms after breast-conserving treatment**

#### **What is breast-conserving treatment?**

Removing the entire breast (mastectomy) is one way of treating breast cancers. Most breast cancers can now be treated just as well with breast-conserving treatment (BCT), which does not remove the entire breast. *Lumpectomy*, one type of BCT, removes a cancerous lump and a narrow edge of the nearby normal breast tissue.

Partial or segmental mastectomy may also be called a *quadrantectomy*. This BCT removes less than the whole breast, but more tissue than a lumpectomy. It takes out only the part of the breast where the cancer was found, along with a margin of healthy breast tissue around the tumor.

BCT is almost always followed by radiation treatment.

A woman who has had BCT will need to continue having mammograms of the affected breast and her opposite breast.

## **Typical mammogram plan**

Most radiologists recommend that women have a mammogram of the treated breast 6 months after radiation treatment is finished. Radiation and chemotherapy both cause changes in the skin and breast tissues. These changes show up on the mammogram, making it harder to read. The changes usually peak 6 months after the radiation is completed; the mammogram at this time establishes a new baseline for the affected breast for that woman. Future mammograms will be compared with this one to follow healing and check for recurrence (the cancer coming back). The next exam is then 6 months later when the woman is due for her yearly mammogram of both breasts. Experts differ on the best follow-up plan from this point on. Some prefer a mammogram of the treated breast every 6 months for 2 to 3 years; others suggest that yearly mammograms are enough. Each woman should talk with her doctor about the plan that is best for her.

## **Mammograms after mastectomy**

### **Without breast reconstruction**

Women who have had total, modified radical, or radical mastectomy for breast cancer need no further routine screening mammograms of the affected side (or sides, if both breasts are removed).

*Total or simple mastectomy* removes all of the breast tissue, including the nipple, but does not remove underarm lymph nodes or chest muscle tissue beneath the breast. Sometimes this surgery is done for both breasts (a double mastectomy), most often as preventive surgery in women at very high risk for breast cancer.

*Modified radical mastectomy* removes the breast, skin, nipple, areola, and most of the lymph nodes under the arm on the same side, leaving the chest muscles intact.

*Radical mastectomy* is surgery for breast cancer in which the breast, chest muscles, and all of the lymph nodes under the arm are removed. This surgery is rarely used today. It is mainly used when the cancer has spread to the chest muscles.

Mammograms are usually continued on the unaffected breast each year. This is very important, since women who have had one breast cancer are at higher risk of developing a new cancer in the other breast.

One type of mastectomy that does require a follow-up mammogram is the *subcutaneous mastectomy*. In this operation, the woman keeps her nipple and the tissue just under the skin. Enough breast tissue is left behind to require yearly screening mammograms in these women.

Any woman who is not sure what type of mastectomy she has had or whether she needs mammograms should ask her doctor.

## **With breast reconstruction**

Women who have had a breast removed by total, modified radical, or radical mastectomy and reconstructed (rebuilt) with silicone gel or saline implants do not need routine mammograms. If the woman has had a subcutaneous mastectomy (discussed above), yearly mammograms are still needed.

After mastectomy, some women choose to have a breast reconstructed using tissue from their own bodies, most often the abdomen (lower stomach area). This type of reconstruction is called a TRAM (transverse rectus abdominis myocutaneous) flap reconstruction. A patient who has had a complete (not subcutaneous) mastectomy followed by TRAM flap reconstruction needs no further screening mammograms on the affected side. But if there is an area of the TRAM flap that is of concern on the physical exam, a diagnostic mammogram may be done. Further imaging with ultrasound or MRI may also be helpful.

## **Mammograms after breast enlargement with implants**

Women who have implants are a special challenge for mammogram screening. The x-rays used for imaging the breasts cannot go through silicone or saline implants well enough to show the breast tissue that is over or under it. This means that the part of the breast tissue covered up by the implant will not be seen on the mammogram.

In order to see as much breast tissue as possible, women with implants have 4 extra pictures (2 on each breast) as well as the 4 standard pictures taken during a screening mammogram. In these extra x-ray pictures, called *implant displacement* (ID) views, the implant is pushed back against the chest wall and the breast is pulled forward over it. This allows better imaging of the front part of each breast. Implant displacement views do not work as well in women who have had hard scar tissue form around the implants (*contractures*). They are easiest to take in women whose implants are placed underneath (behind) the chest muscle.

Although these women do have more pictures taken at each mammogram, the guidelines for how often women with implants should have screening mammograms are the same as for women without them.

A ruptured (burst) implant can sometimes be diagnosed on a mammogram, but a ruptured implant will often look normal. Magnetic resonance imaging (MRI), on the other hand, is extremely good at finding an implant rupture. MRI is the best way to check the implant

itself, while mammography is still the best test for evaluating breast tissue. See the section, "Other breast imaging tests" in this document for more information on MRI.

Very rarely, mammograms can cause an implant to rupture. It is very important to tell the technologist if you have implants.

## Improving mammograms

Although a mammogram is an excellent way to find most breast cancers at their earliest and most curable stage, it does not detect all breast cancers. Newer techniques are helping to make mammograms more accurate.

### Digital mammograms

Digital mammogram (also known as *full-field digital mammography* or *FFDM*) is much like a standard, film-screen mammogram in that x-rays are used to make a picture of the breast. The differences are in the way the picture is recorded, looked at by the doctor, and stored. Standard mammogram pictures are recorded on large sheets of photographic film. Digital mammograms are recorded and stored on a computer. After the exam, the doctor can look at them on a computer screen and adjust the image size, brightness, or contrast to see certain areas more clearly. Digital images can also be sent electronically from one site to another to consult with breast specialists at another location. Many centers do not offer the digital option, but it is becoming more widely available with time.

For the most part, regular screen-film mammograms and digital mammograms have similar accuracy. But digital mammograms have been shown to have some unique advantages. Some studies have found that women who have questionable areas on their mammogram have to return less often for extra imaging tests because with digital mammograms the original image can be magnified and looked at in many different ways on the computer screen. Several studies have also found that digital mammograms were more accurate in finding cancers in women younger than 50 and in women with dense breast tissue. It is important to remember that standard film mammograms also work well for these groups of women, and that women should still get their regular mammogram if digital mammography is not available.

### Computer-aided detection and diagnosis

Over the past 20 years, computer-aided detection and diagnosis (CAD) has been developed to help radiologists find suspicious areas on mammograms. This can be done with standard film mammograms or with digital mammograms.

Computers can help doctors find abnormal areas on a mammogram by acting as a second set of eyes. For standard mammograms, the film is fed into a machine which converts the image into a digital signal that is then analyzed by the computer. The technology can also be applied to an image captured with a digital mammogram. The computer then displays the picture on a video screen, with markers pointing to areas the radiologist should check more closely.

CAD can be helpful when used by a skilled doctor, increasing the rate at which breast cancer is detected. In effect, it is like getting 2 readings. But CAD is not a substitute for experience and expertise in reading mammograms. It works better for obvious masses and calcifications, but not for subtle findings. If the doctor reading the mammogram is not experienced, CAD probably will not improve the accuracy of breast cancer detection, but it will increase the false-positive rate and the number of women who are referred for biopsy. Further research of this approach is needed.

## Other breast imaging tests

While mammograms are the most useful tests for screening and finding breast cancer early, other imaging tests may be helpful in some cases.

### MRI (magnetic resonance imaging)

For certain women at high risk for breast cancer, screening MRI is recommended along with a yearly mammogram. MRI is not generally recommended as a screening tool by itself, as it might miss some cancers that a mammogram would detect.

MRI scans use magnets and radio waves instead of x-rays to produce very detailed, cross-sectional pictures of the body. The most useful MRI exams for breast imaging use a contrast material (called *gadolinium*) that is injected into a vein in the arm before or during the exam. This helps to clearly show breast tissue details.

Just as mammograms are done with x-ray machines that are specially designed to image the breasts, breast MRI also requires special equipment. Breast MRI machines produce higher quality images than MRI machines designed for head, chest, or abdominal scanning. But many hospitals and imaging centers do not have dedicated breast MRI equipment available.

It is also important that screening MRIs are only done at facilities that also can do an MRI-guided breast biopsy. Otherwise, the entire scan will need to be repeated at another facility if a biopsy is needed.

MRIs cost more than mammograms. Most major insurance companies will probably pay for these screening tests if a woman can be shown to be at high risk, but it's not yet clear if all companies will do so. At this time there are concerns about costs of and limited access to high-quality MRI breast screening services for women at high risk of breast cancer.

In getting ready for a breast MRI, you can eat and drink as usual. You will need to take off clothes with metal parts such as zippers, snaps, or buttons, and put on a gown or top. Jewelry, hairpins, safety pins, and anything else made of metal must be removed before you go into the MRI room. The technologist will ask if you have any metal in your body, such as surgical clips, staples, pacemakers, artificial joints, metal fragments, tattoos, permanent eyeliner, and so on. Some metal objects will not cause problems, but others might. Tell the staff before the scan if you have any allergies, if you have breast implants, or if you are pregnant or breast-feeding. You may need to have an IV put in for contrast

dye to help outline the structures of the breast. For the actual MRI, you will lie on your stomach on a padded platform with spaces for your breasts. You will need to be very still during the test, which takes about 30 to 45 minutes.

## Breast ultrasound

Ultrasound, also known as *sonography*, uses high-frequency sound waves to look inside a part of the body. A handheld instrument placed on the skin transmits the sound waves through the breast. Echoes from the sound waves are picked up and translated by a computer into a black and white picture that is shown on a computer screen. This test is painless and does not expose you to radiation.

Breast ultrasound is sometimes used to evaluate breast problems that are found during a screening or diagnostic mammogram or on physical exam. Breast ultrasound is not routinely used for screening. Some studies have suggested that it may be helpful to use ultrasound along with a mammogram when screening women with dense breast tissue (which is hard to evaluate with a mammogram). But at this time, ultrasounds cannot replace mammograms. More studies are needed to figure out if ultrasound should be added to routine screening mammograms for some groups of women.

Ultrasound is useful for taking a closer look at some breast masses, and it is the only way to tell if a suspicious area is a cyst without putting a needle into it to remove (aspirate) fluid. Cysts cannot be diagnosed by physical exam alone. Breast ultrasound may also be used to help doctors guide a biopsy needle into some breast lesions (or areas of concern).

Ultrasound has become a valuable tool to use along with mammograms because it is widely available, non-invasive, and costs less than other options. But the value of an ultrasound test depends on the operator's level of skill and experience. Although ultrasound is less sensitive than MRI (that is, it detects fewer tumors), it has the advantage of costing less and being more available.

## Ductogram (galactogram)

A ductogram is a test that is sometimes helpful in finding the cause of a nipple discharge. In this test, a very thin plastic tube is put into the opening of a duct in the nipple. A small amount of contrast material is put in. It outlines the shape of the duct on x-ray and shows whether there is a mass inside the duct.

## Ductal lavage and nipple aspiration

Ductal lavage and nipple aspiration are not imaging tests, but they are mentioned here because of the confusion that sometimes surrounds them.

*Ductal lavage* is an experimental test developed for women who have no symptoms of breast cancer, but are at very high risk for breast cancer. It is not a test to screen for or diagnose breast cancer, but it may help give a better picture of a woman's risk of developing it.

Ductal lavage can be done in a doctor's office or an outpatient facility. An anesthetic cream is used to numb the nipple area. Gentle suction is then used to help draw tiny amounts of fluid from the milk ducts up to the nipple surface. This helps locate the milk ducts' natural openings. A tiny tube (called a catheter) is then put into a milk duct opening. Saline (salt water) is slowly put into the catheter to gently rinse the duct and collect cells. The ductal fluid is pulled out through the catheter and sent to a lab, where the cells are looked at under a microscope.

Ductal lavage is not thought to be helpful for women who aren't at high risk for breast cancer. It is not clear whether it will ever be a useful test. It has not been shown to detect cancer early. It is more likely to be useful as a test of cancer risk rather than as a screening test for cancer. More studies are needed to better define its usefulness.

*Nipple aspiration* also looks for abnormal cells from the ducts, but it is much simpler because nothing is put into the breast. The device for nipple aspiration uses small cups that are placed on the woman's breasts. The device warms the breasts, gently compresses them, and applies light suction to bring nipple fluid to the surface of the breast. The nipple fluid is then collected and sent to a lab for testing. As with ductal lavage, the procedure may be useful as a test of cancer risk, but it is not thought to be helpful as a screening test for cancer. The test has not been shown to detect cancer early.

## Newer and experimental breast imaging methods

Research in the field of breast imaging is continuing in order to

- Find more cancers even before they can be felt by the patient or her doctor
- Find even smaller cancers than those now detected by mammograms
- Find better ways to tell the difference between benign (not cancer) breast conditions and breast cancers

Tests being developed for these purposes need more study before their usefulness can be determined.

## Nuclear medicine studies

For nuclear medicine studies (also called nuclear scans) small amounts of slightly radioactive substances are injected into the body and special cameras are used to see where they go. Depending on the substance used, different types of abnormalities may be found. Unlike most other imaging tests that are based on changes tumors cause in the body's structure, nuclear medicine scans depend on changes in tissue metabolism.

## Scintimammography (molecular breast imaging)

A radioactive tracer known as *technetium sestamibi* has been studied to help detect breast cancer. This test is marketed under the trade name Miraluma®. For this test, a small amount of the radioactive tracer is put into an arm vein. The tracer attaches to "hot spots" and is detected by a special camera.

This test cannot show whether an abnormal area is cancer as accurately as a routine mammogram, and it is not used as a screening test. Some radiologists believe this test may be useful in looking at suspicious areas found by mammogram. But the exact role of scintimammography is still unclear. Current research is aimed at improving the technology and evaluating its use in certain situations such as in the dense breasts of younger women. Some early studies have suggested that it may be about as accurate as more expensive MRI scans in some situations. But more research is needed.

## Tomosynthesis (3-D mammography)

This technology is basically an extension of a digital mammogram. For this test, a woman lies face down with her breast hanging through a hole in the table, while a machine takes x-rays as it rotates around the breast. Tomosynthesis allows the breast to be looked at as many thin slices, which can be combined into a 3-dimensional picture. It may allow doctors to detect smaller lesions or ones that might be hidden with standard mammograms. This technology is still considered experimental and is not yet available other than in clinical trials.

## Electrical impedance imaging (T-scan)

Electrical impedance imaging scans the breast for electrical conductivity, based on the idea that breast cancer cells conduct electricity in a different way than do normal cells. The test passes a very small electrical current through the body and then detects it on the skin of the breast with a small probe (much like an ultrasound probe). It does not use radiation or compress the breasts.

This test is FDA-approved as a diagnostic aid in helping classify tumors found on mammogram. But it has not had enough clinical testing to be used in breast cancer screening.

## Thermography (thermal imaging)

Thermography is a way to measure and map the heat on the surface of the breast using a special heat-sensing camera. It is based on the idea that the temperature rises in areas with increased blood flow and metabolism, which could be a sign of a tumor.

Thermography has been around for many years, and some scientists are still trying to improve the technology to use it in breast imaging. But no study has ever shown that it is an effective screening tool for finding breast cancer early. It should not be used as a substitute for mammograms.

Newer versions of this test are better able to find very small temperature differences. They may prove to be more accurate than older versions, and are now being studied to find out if they might be useful in finding cancer.

## Other experimental imaging tests

Some newer techniques are now being studied for breast imaging.

### Optical imaging

This test either passes light through the breast or reflects light off it and then measures the light that returns. The technique does not use radiation and does not require breast compression. Optical imaging might be useful at some point for detecting tumors or the blood vessels that supply them.

One example of optical imaging is computed tomography laser mammography (CTLM). This test passes a harmless laser light through the breast tissue and detects large areas of blood vessels that could be a sign of breast tumors. CTLM is being studied for use along with mammogram to reduce the number of false-positive tests. It has not yet been approved by the FDA.

Other experimental techniques now being studied include optoacoustic tomography (sending laser light pulses through the breast and detecting the sound waves they cause) and microwave imaging. These techniques are still in the earliest stages of research.

## Additional resources

### More information from your American Cancer Society

The following related information may also be helpful to you. These materials may be ordered from our toll-free number, 1-800-227-2345.

After Diagnosis: A Guide for Patients and Families (also available in Spanish)

Breast Cancer (also available in Spanish)

Breast Cancer Dictionary (also available in Spanish)

Breast Cancer Early Detection (also available in Spanish)

Breast Cancer in Men

Inflammatory Breast Cancer

Breast Reconstruction After Mastectomy (also available in Spanish)

For Women Facing a Breast Biopsy (also available in Spanish)

Non-Cancerous Breast Conditions (also available in Spanish)

Talking with Your Doctor (also available in Spanish)

## National organizations and Web sites\*

Along with the American Cancer Society, other sources of information and support include:

### **National Cancer Institute**

Toll-free number: 1-800-422-6237 (1-800-4-CANCER)

Web site: [www.cancer.gov](http://www.cancer.gov)

Offers current information about breast cancer screening, diagnosis, and treatment as well as information on other types of cancer

### **Susan G. Komen for the Cure**

Toll-free number: 1-877-465-6636

Web site: [www.komen.org](http://www.komen.org)

Offers information on breast health and breast cancer; tools, including videos and quizzes. Some written materials in Spanish, Arabic, Chinese, Vietnamese, Russian, and Korean

### **Y-Me National Breast Cancer Organization (formerly Breast Cancer Network of Strength)**

Toll-free number: 1-800-221-2141,

Toll-free number for Spanish: 1-800-986-9505

Web site: [www.networkofstrength.org](http://www.networkofstrength.org)

Patients and survivors may be matched with someone who has had the same diagnosis and is the same age. Partners of breast cancer patients may also get support from others.

### **Centers for Disease Control and Prevention (CDC)**

#### **National Breast and Cervical Cancer Early Detection Program (NBCCEDP)**

Toll-free number: 1-800-232-4636 (1-800-CDC-INFO)

Web site: [www.cdc.gov/cancer/bbccedp](http://www.cdc.gov/cancer/bbccedp)

To find out more about the NBCCEDP, which provides breast and cervical cancer early detection testing for women without health insurance for free or at very little cost

*\*Inclusion on this list does not imply endorsement by the American Cancer Society.*

No matter who you are, we can help. Contact us anytime, day or night, for cancer-related information and support. Call us at **1-800-227-2345** or visit [www.cancer.org](http://www.cancer.org).

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